

# Reaching Towards Zero: Local Energy Ordinances Forge a Path

SEEC Forum 2017

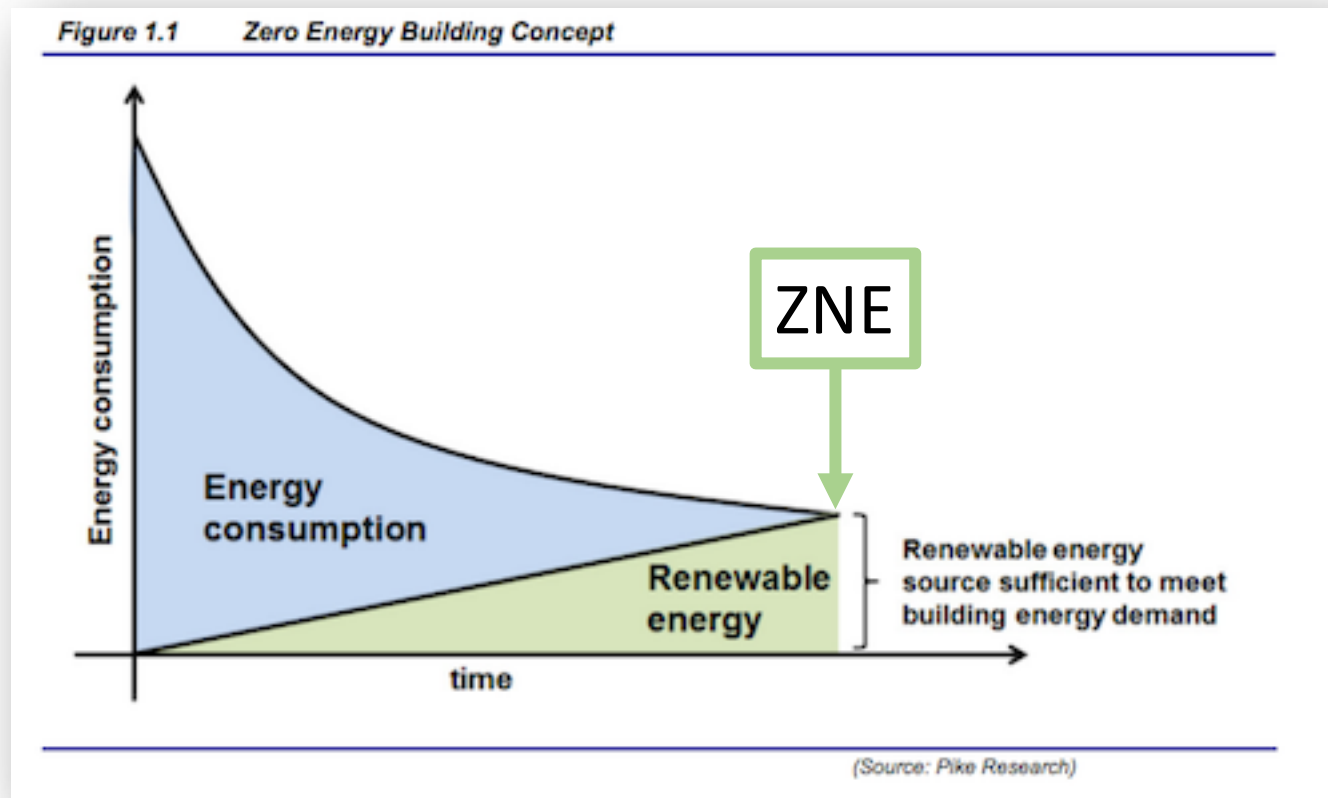
Chris Kuch, P.E.

Statewide Codes and Standards Reach Code Program



# What is the state of CA Residential ZNE?

# ZNE Theory



# ZNE Reality

## Decreasing value of rooftop PV

- Supply and demand: Mid-day over-generation
- Changes to Net Energy Metering (NEM) compensation
- Diminished carbon reduction benefits





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# ZNE Reality

## Decreasing value of rooftop PV

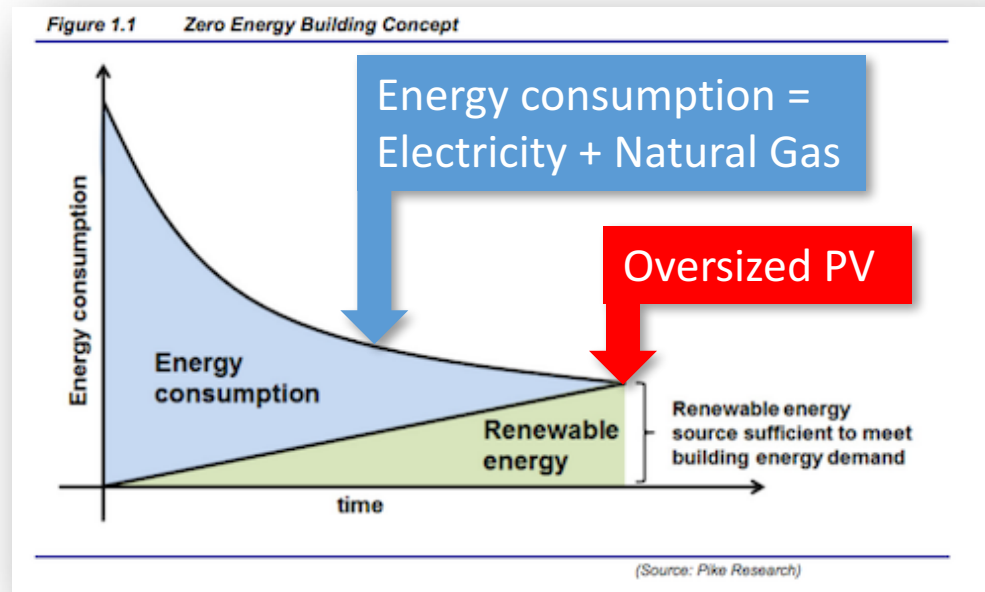
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- Changes to Net Energy Metering (NEM) compensation
- Diminished carbon reduction benefits



# ZNE Reality

## Increasing need for electric grid harmonization

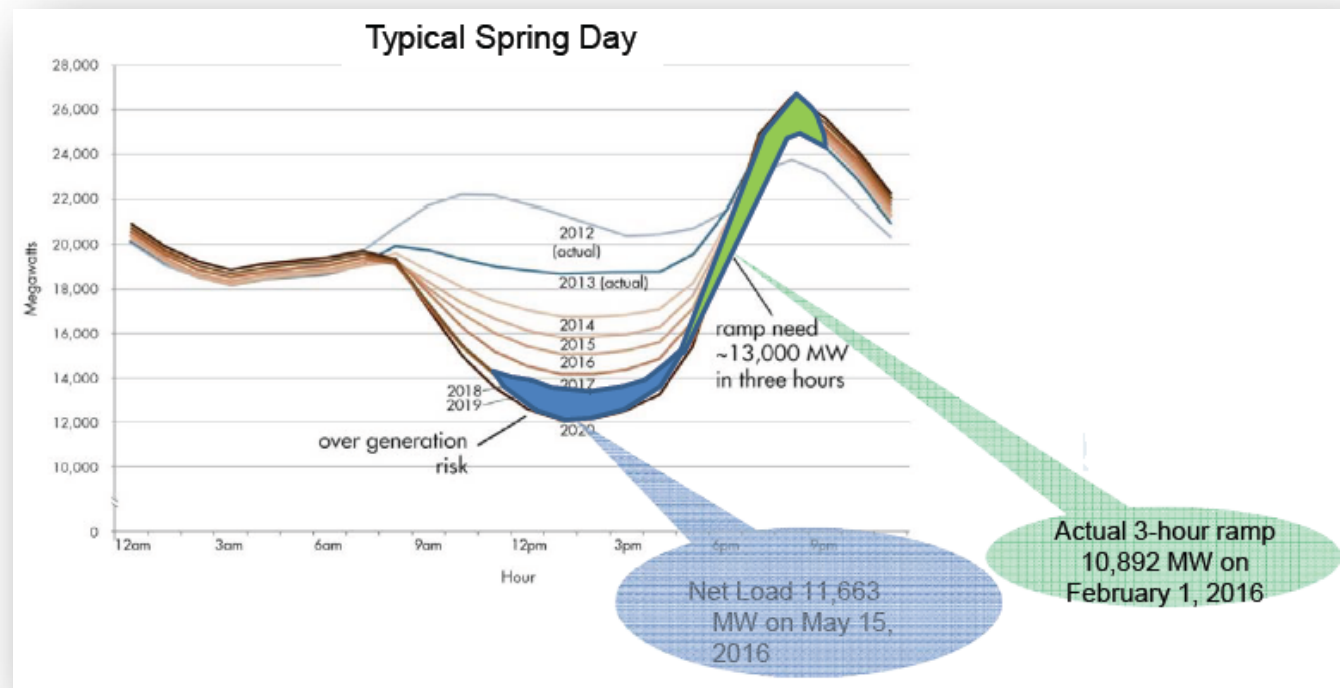
- ZNE theory promotes oversized solar PV



# ZNE Reality

## Increasing need for electric grid harmonization

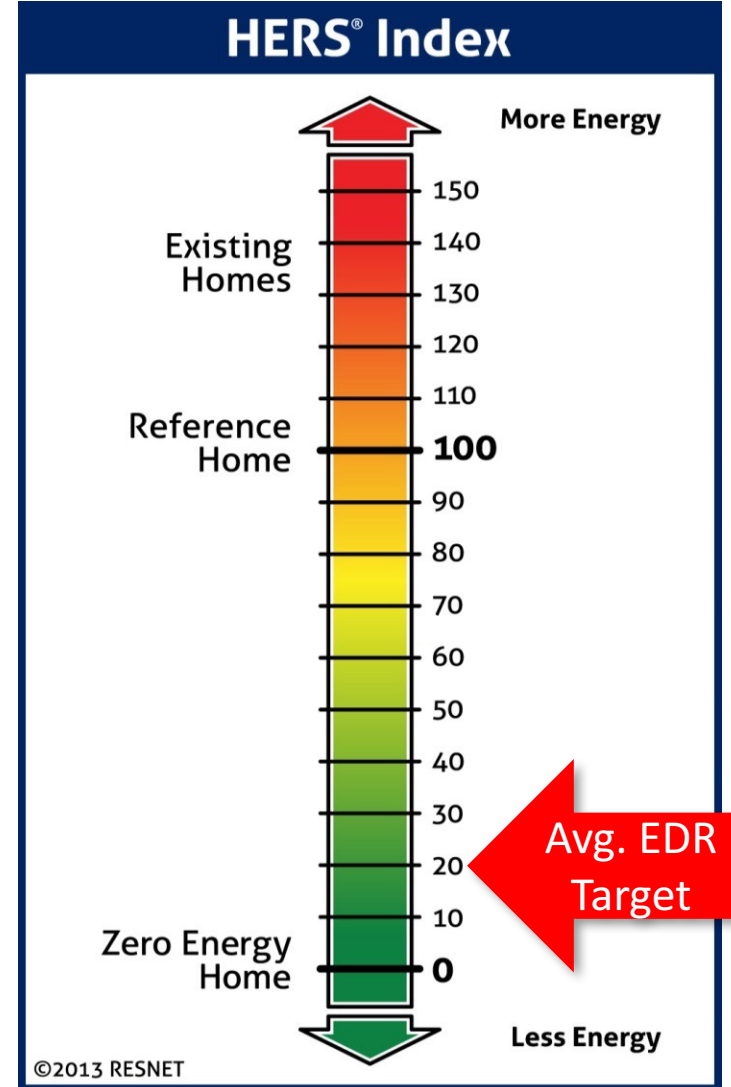
- ZNE theory promotes oversized solar PV
- “Duck Curve” Issues: Oversupply and Ramping



Where are we headed with  
CA Residential ZNE?

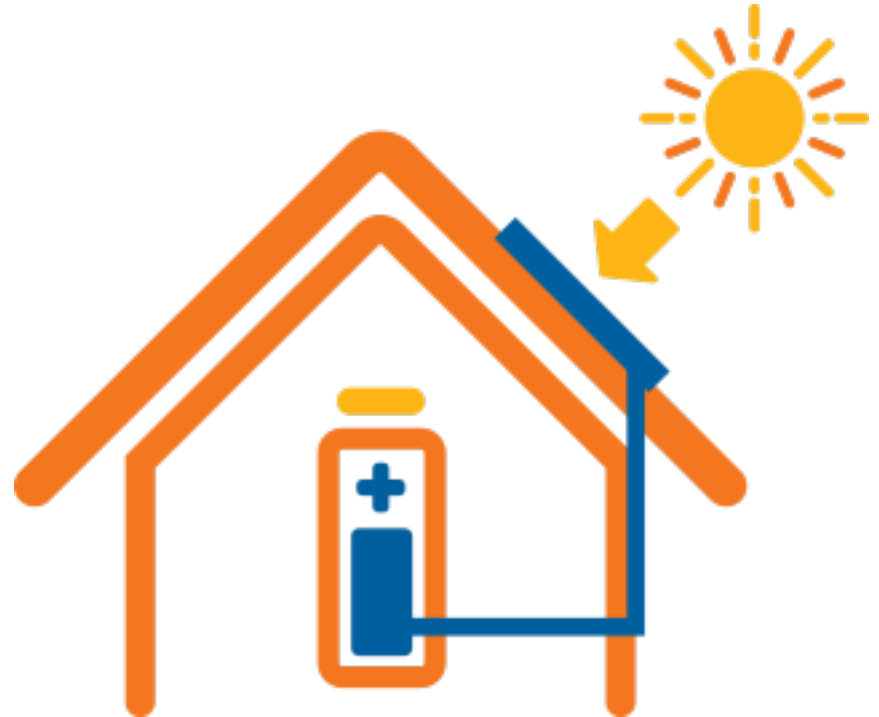
# 2019 Title 24 Developments

- **Prescriptive requirement** to size PV to displace only annual site kWh
  - Cost-effective
  - Grid friendly
- Energy Code compliance will be based on an **Energy Design Rating (EDR)** score
  - EDR target scores for each climate zone
  - EDR target = Energy Efficiency + PV
  - Average EDR target score ~20



## 2019 Title 24 Developments (cont.)

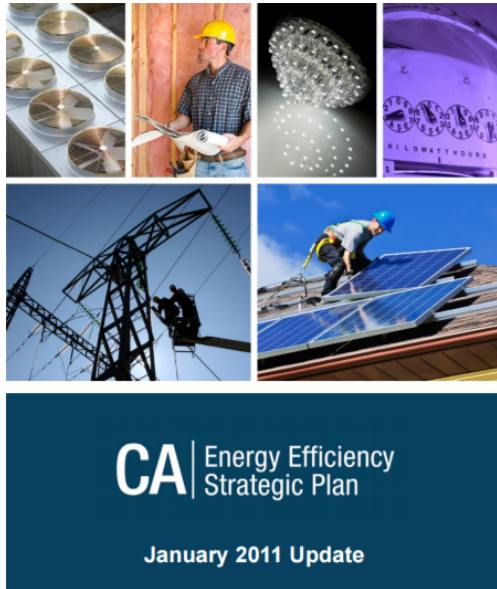
- Battery Storage
  - **Not** prescriptively required for 2019 code cycle
  - Potential viable path to reach ZNE (EDR = 0)
  - Area for Reach Code research and development





# How can Local Governments help California reach ZNE?

# Answer: Reach Codes



*“A broad range of aggressive and continually improving minimum and higher **voluntary sets of energy codes** and standards will be adopted to **greatly accelerate** the widespread deployment of **zero-net energy** and highly efficient buildings and equipment...”*

*– California Energy Efficiency Strategic Plan*

# Statewide Codes & Standards Reach Code Program



Develop cost effectiveness studies

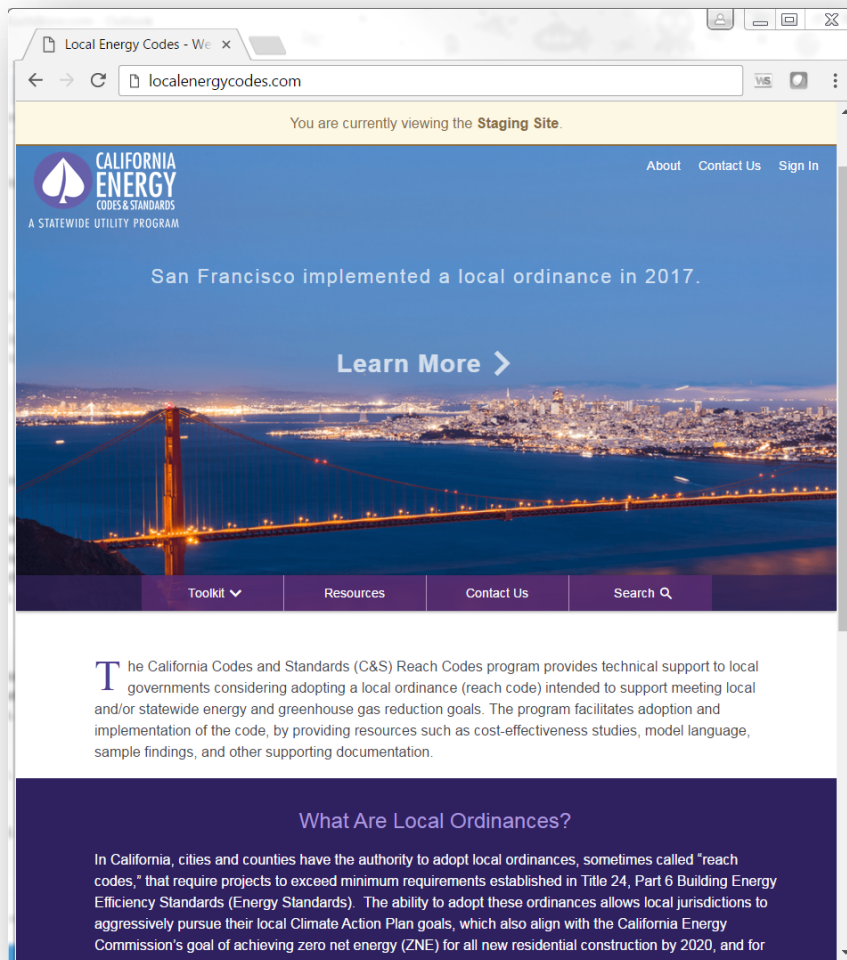


Coordinate with LGC & Regional Energy Networks



Create tools to support Reach Code adoption

# Tool Kit Website – Coming Soon!



- Database for up-to-date Cost-Effectiveness Studies
- Model ordinance language templates
- Other supporting documents

# Contact Info

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  - [MBH9@pge.com](mailto:MBH9@pge.com)
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  - [Jbarbour@semprautilities.com](mailto:Jbarbour@semprautilities.com)
- **Ingrid Neumann – California Energy Commission**
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# Mandatory Solar in New Home Construction



Case Study



# Presentation Overview

1. BACKGROUND ON FREMONT
2. THE CASE FOR RESIDENTIAL SOLAR
3. ADOPTION PROCESS



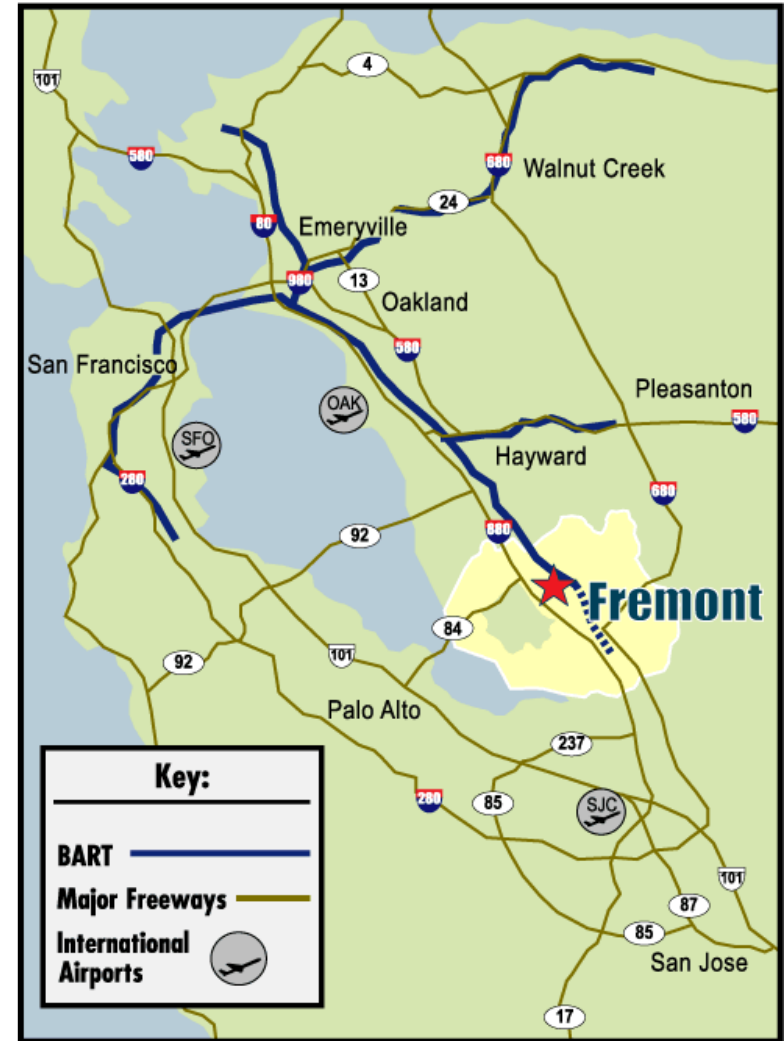
# Background on Fremont Sustainability Efforts





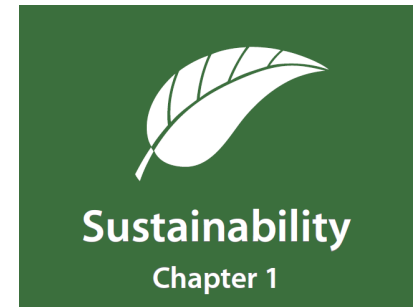
# About Fremont, CA

- Located in Alameda County
- Incorporated in 1956
- From historic farmland → suburban sprawl
- Current population of 232,206
- 4<sup>th</sup> largest City in Bay Area
- 92 sq. mi.
- “Silicon Valley East”

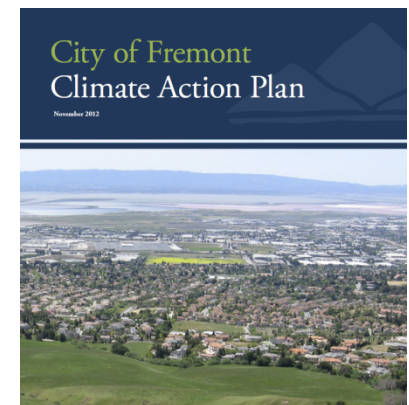


# Fremont's Sustainability Vision

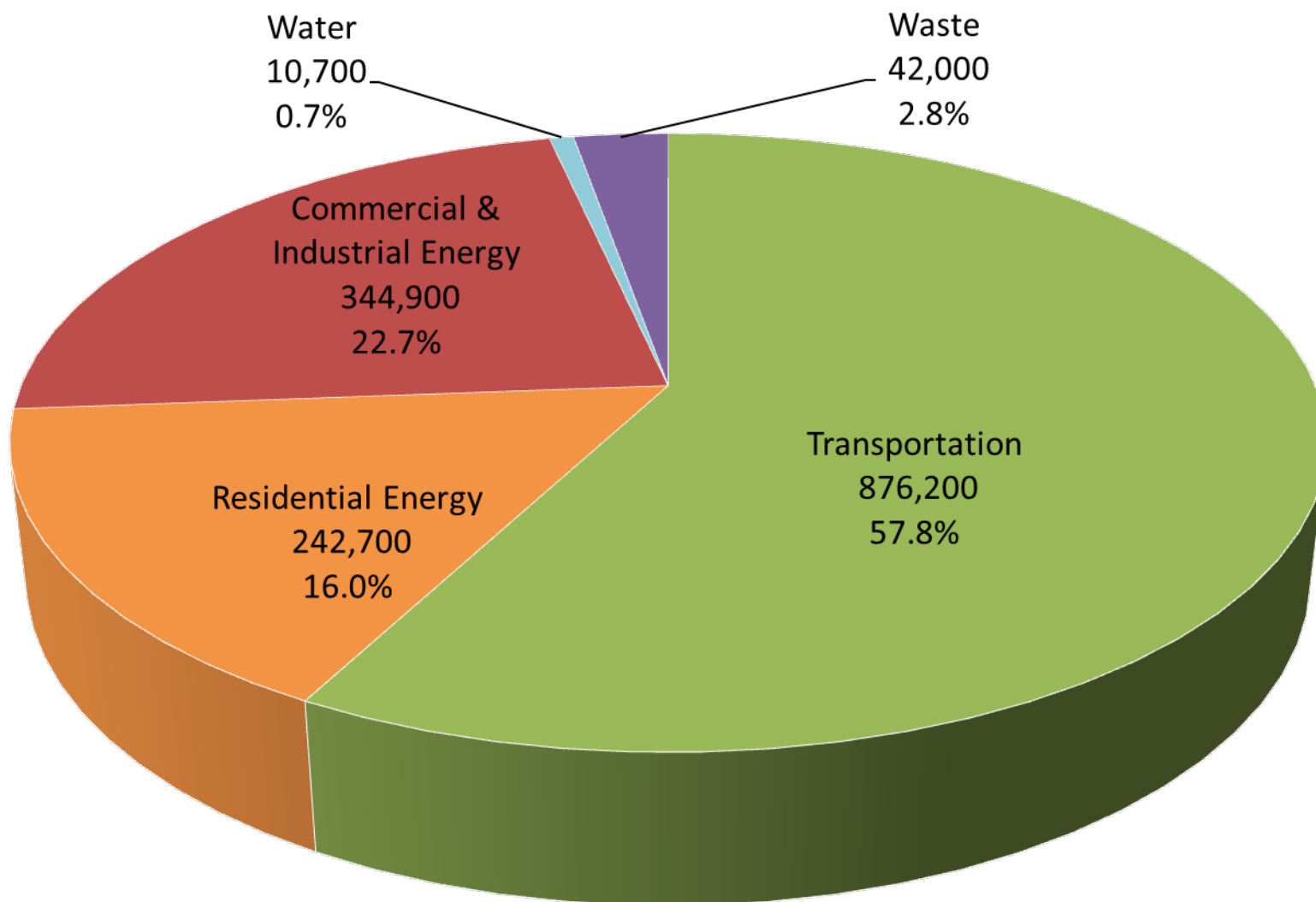
- General Plan (December 2011)
  - *Sustainability Element* as 1<sup>st</sup> Chapter
  - Fremont to “serve as a national model of how an auto-oriented suburb can evolve into a sustainable, strategically urban, modern city.”
- Climate Action Plan (November 2012)
  - Roadmap for reducing the City's GHG emissions 25% by 2020 from a 2005 baseline.



City of Fremont  
General Plan  
Adopted December 2011



# Fremont's GHG Emissions by Sector (MTCO<sub>2</sub>e)



# GHG Emissions by Household

## Household Comparison

- A Fremont home emits an average of 3.65 MTCO<sub>2</sub>e every year.

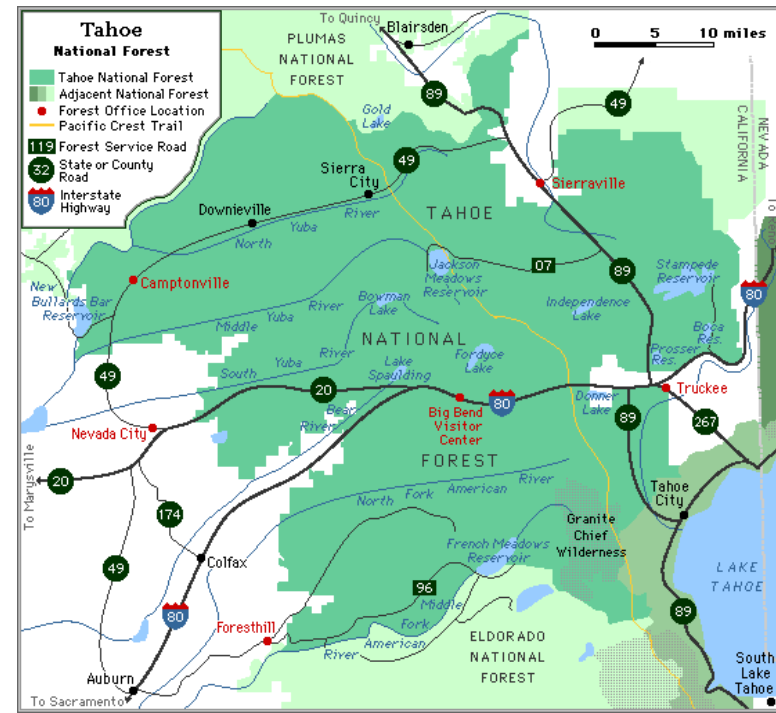
## Vehicle Comparison

- Over 1 year, a standard passenger vehicle emits 4.75 MTCO<sub>2</sub>e.

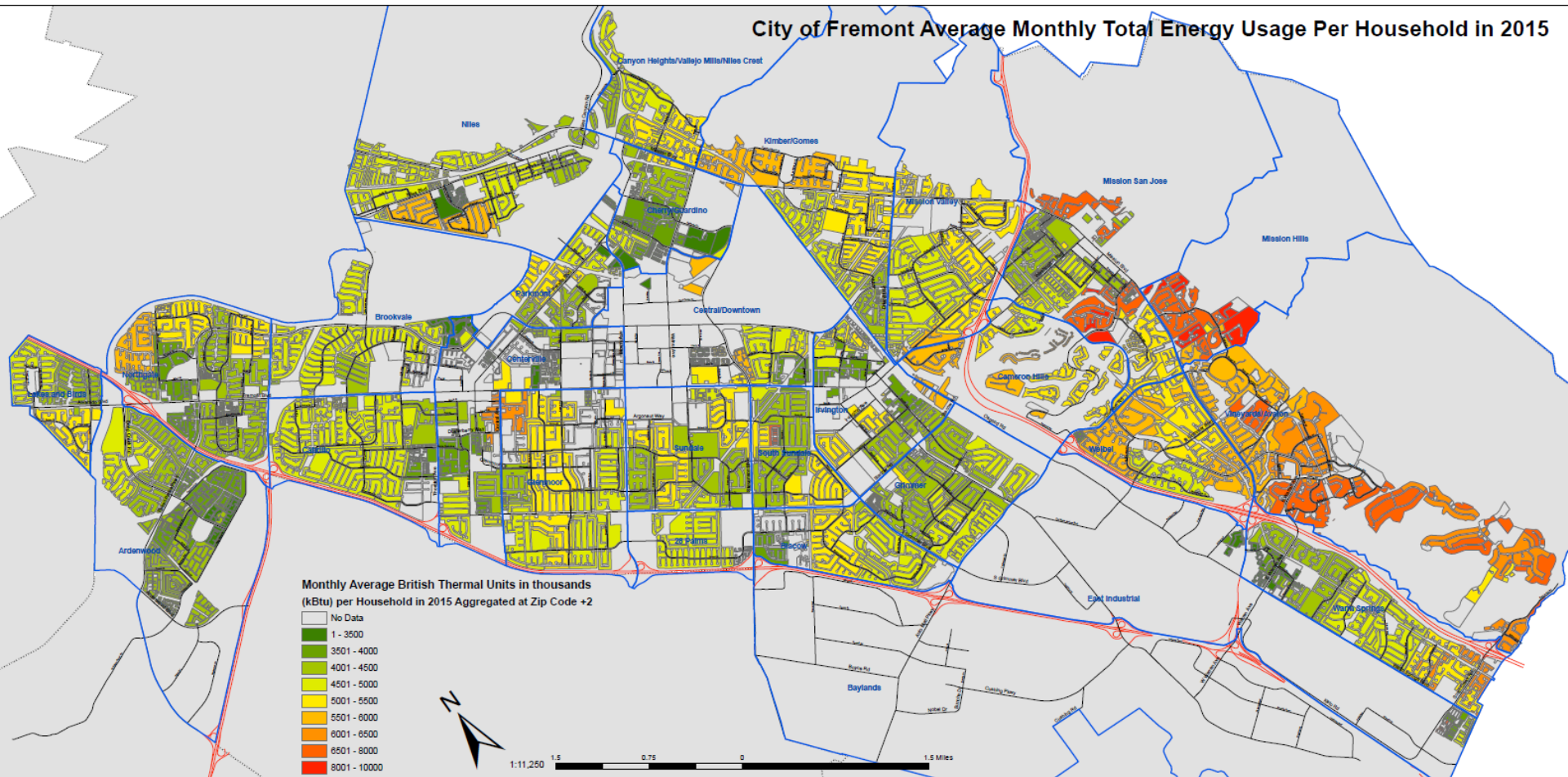
## GHG Equivalency

- It would take over 1,000 mi<sup>2</sup> of forest to sequester the total CO<sub>2</sub> emitted by Fremont's households & passenger vehicles.

~2/3 Tahoe National Forest



# Average Household Energy Usage by Fremont Neighborhood



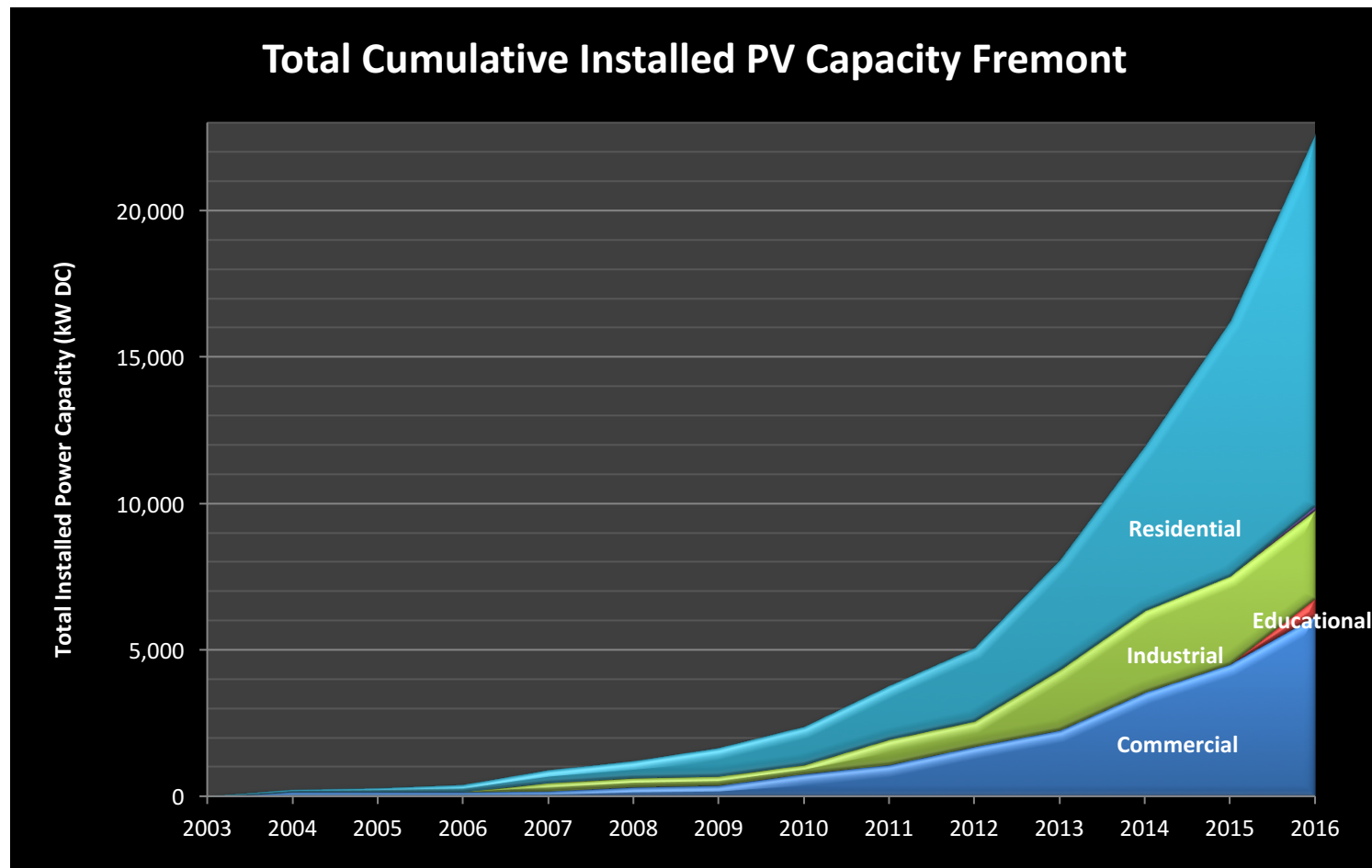


# The Case for Requiring Solar



# Existing Solar in Fremont

- 22.6 MW of solar installed by end of 2016:
  - 2,837 homes (12.7 MW) & 70 businesses (9.9 MW)





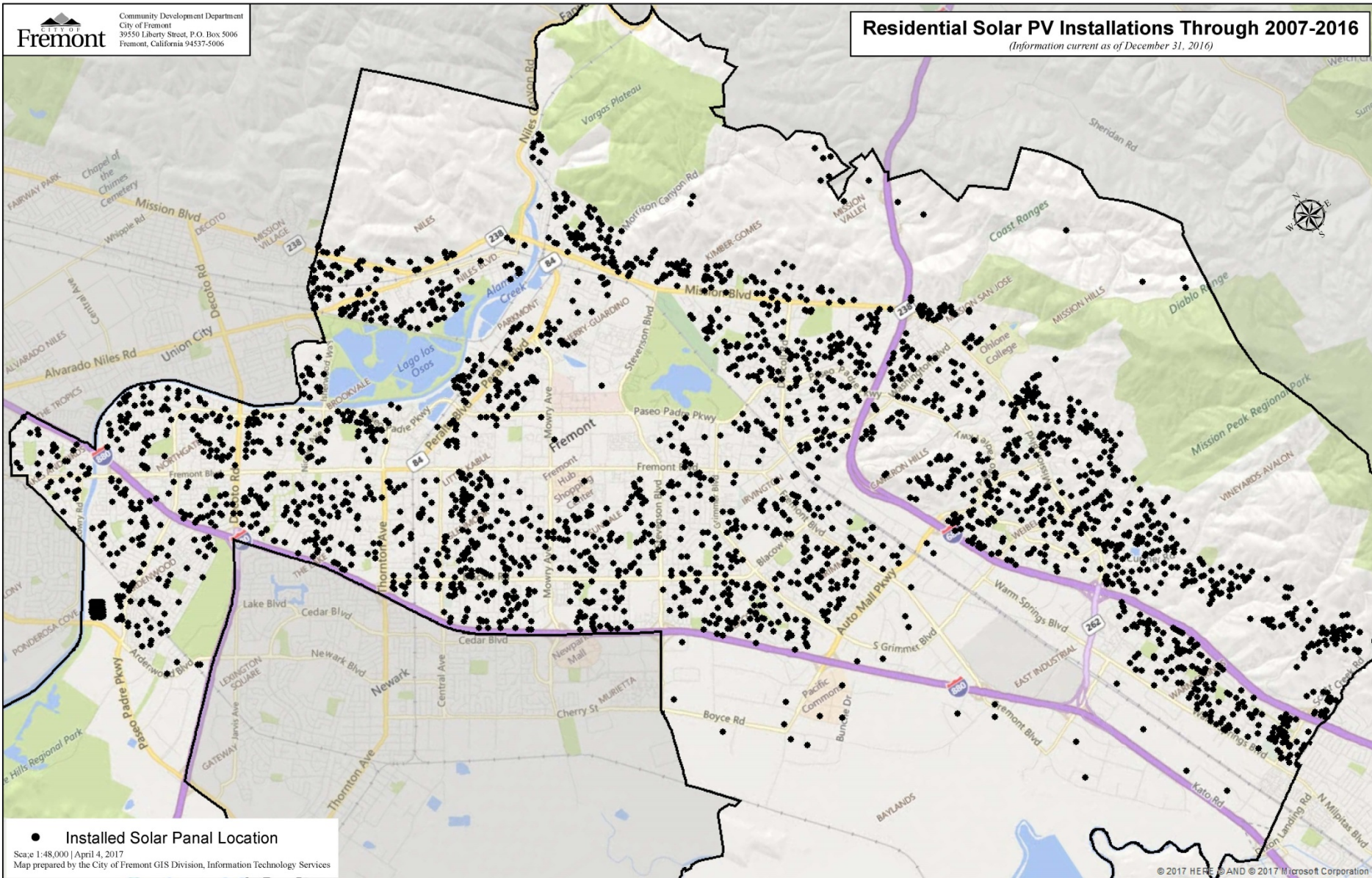
# Residential Solar Installations



Community Development Department  
City of Fremont  
39550 Liberty Street, P.O. Box 5006  
Fremont, California 94537-5006

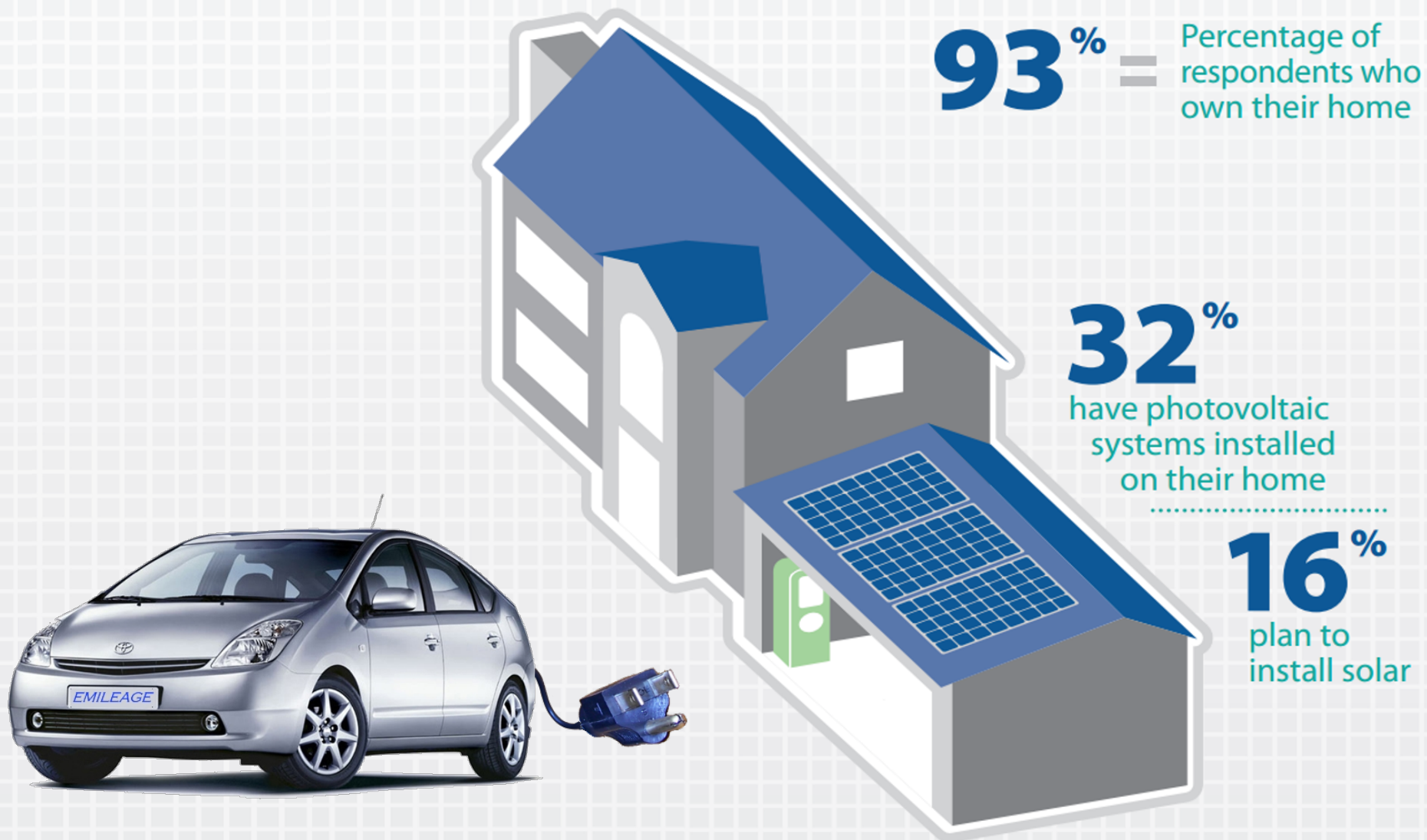
## Residential Solar PV Installations Through 2007-2016

(Information current as of December 31, 2016)





# The EV-PV Connection



# EV Ownership in Fremont

- Almost 5,000 EV owners in Fremont (Dec 2016 CVRP Data)
- 1/3 of all EVs in Alameda County with only 14% population
- 94539 has more EVs than any other zip code in CA!



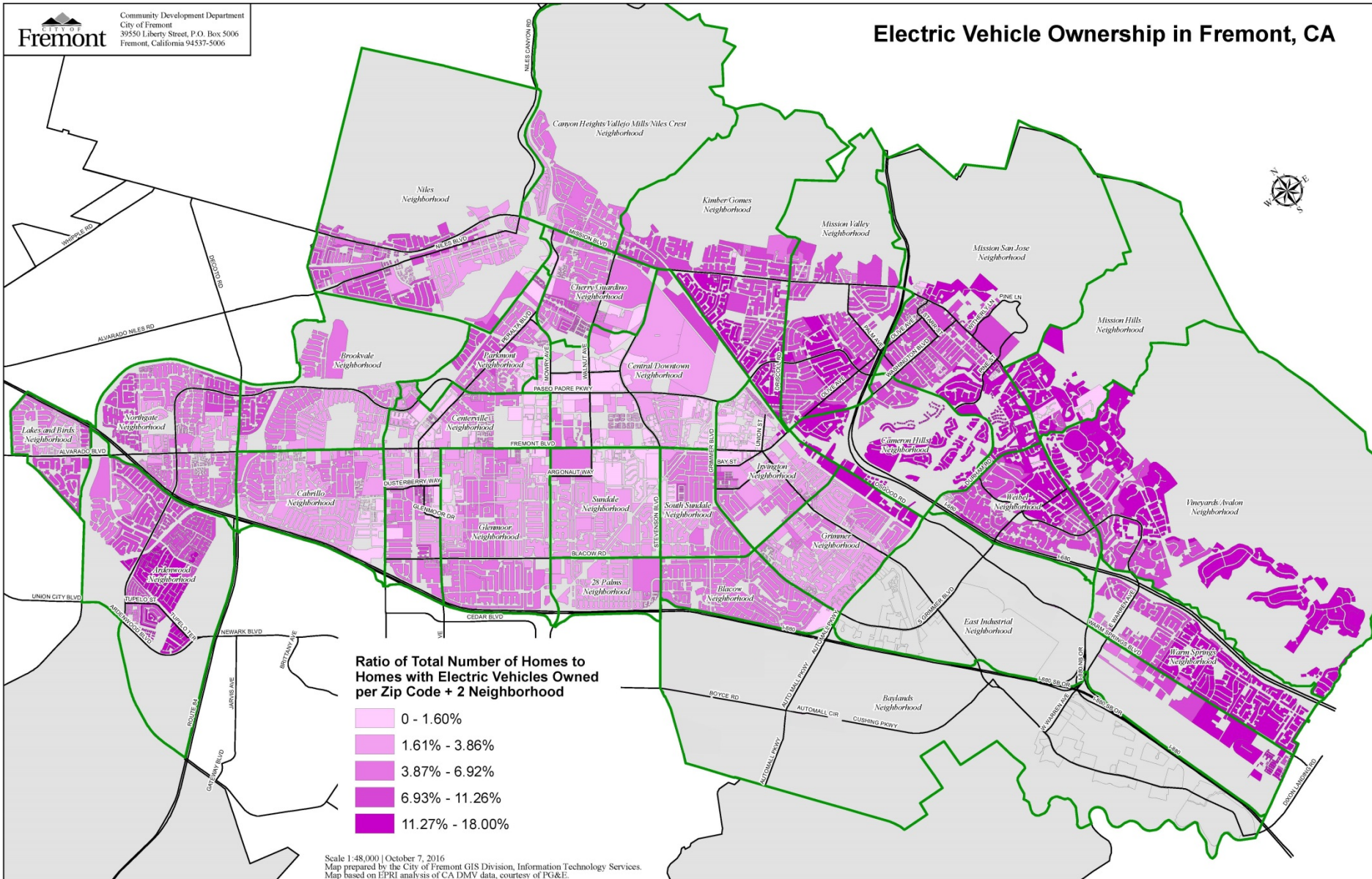


# EV Concentrations by Neighborhood



Community Development Department  
City of Fremont  
39550 Liberty Street, P.O. Box 5006  
Fremont, California 94537-5006

## Electric Vehicle Ownership in Fremont, CA



# New Residential Developments

- 75,420 existing housing units (3.8% have PV)
  - 6,229 new units planned before 2020
- = Major opportunity for new solar installs!

|                           | Projected<br># of Units | Est Ave Sq<br>Ft per Unit | Total Sq Ft | Min PV<br>System Size | Potential<br>PV Installed |
|---------------------------|-------------------------|---------------------------|-------------|-----------------------|---------------------------|
| Single Family<br>Detached | 782                     | 2,700                     | 2.1M        | 2.7 kW                | 2,111 kW                  |
| Single Family<br>Attached | 1,399                   | 1,650                     | 2.3M        | 2.1 kW                | 2,938 kW                  |
| Multifamily               | 4,048                   | 1,050                     | 4.3M        | 1.7 kW                | 6,882 kW                  |
| <b>TOTAL</b>              | <b>6,229</b>            |                           |             |                       | <b>11.9 MW</b>            |

# Mandatory Solar Ordinance Adoption Process



# Process Timeline

Mar. 3, 2016: Sustainability Commission receives presentation on Building Code Adoption Process from City Plan Check Manager

Mar. 15, 2016: City Council referral for Sustainability Commission to evaluate local amendments to 2016 Building Code

Aug. 11, 2016: Sustainability Commission receives presentation on reach code options from City Building Official and from consulting firms Build It Green and Energy Solutions

Early Sept., 2016: Staff gathers information on and interviews other cities with mandatory solar ordinances; develops draft ordinance based on findings

# Other Cities with Mandatory Solar

| Jurisdiction  | Requirement   | Enacted | In Effect |
|---------------|---|---------|-----------|
| Culver City   | <u>Requirement</u> = 1 kW solar per every 10,000 sf in new MF and Non-Res construction or renovations over 10,000 sf.   | Mar-08  | Spring-08 |
| Sebastopol    | <u>Requirement</u> = 2 watts/sf conditioned space, or 75% of electric load in new Res & Non-Res, alterations over 50% sf, or additions over 1,800 sf.<br><u>Alternatives</u> = Other renewable energy sources, exceed mandatory energy reqs. by 10%, or fee paid by builder.  | May-13  | Jul-13    |
| Lancaster     | <u>Requirement</u> = 1-1.5 kW over 7,000 sf lots   1.5+ kW over 100,000 sf lots.<br>Builders can aggregate requirements of a subdivision & divide among units.<br><u>Alternatives</u> = Builders can meet requirement through purchase of RECs.   | Mar-13  | Nov-13    |
| Santa Monica  | <u>Requirement</u> = 1.5 watts/sf conditioned space new Res; 2 watts/sf of building footprint new MF & Non-Res.<br><u>Exception</u> = Provision reduced or waived due to lack of unshaded areas.  | Apr-16  | May-16    |
| San Francisco | <u>Requirement</u> = 10 watts/sf of solar PV and/or 100 kBtu/sf of solar hot water for "solar zone" area (15% of roof area) in all new construction ≤10 stories with min. 2,000 sf gross floor area & min. 150 sf solar area.<br><u>Exceptions</u> = Laboratories and internet server operations.<br><u>Alternatives</u> = Installation of living roof. | Apr-16  | Jan-17    |
| San Mateo     | <u>Requirement</u> = ≥1 kW new SF Res; ≥2 kW new MF 3-16 units; ≥3 kW new MF 17+ units & Non-Residential <10,000 sf; ≥5 kW new Non-Res 10,000+ sf.<br><u>Alternatives</u> = ≥40 sf collector solar hot water system.  | May-16  | Jan-17    |



# Process Timeline (con't)

Sept. 15, 2016: Sustainability Commission recommends specific Reach Code amendments to 2016 Building Code Adoption

Late Sept, 2016: Staff learns that CEC is working on Cost-Effectiveness Study & Template Ordinance using current PV cost information

Oct. 7, 2016: Staff attends meeting with BAAQMD, MTC, BARC, and CEC to discuss Draft Template Ordinance

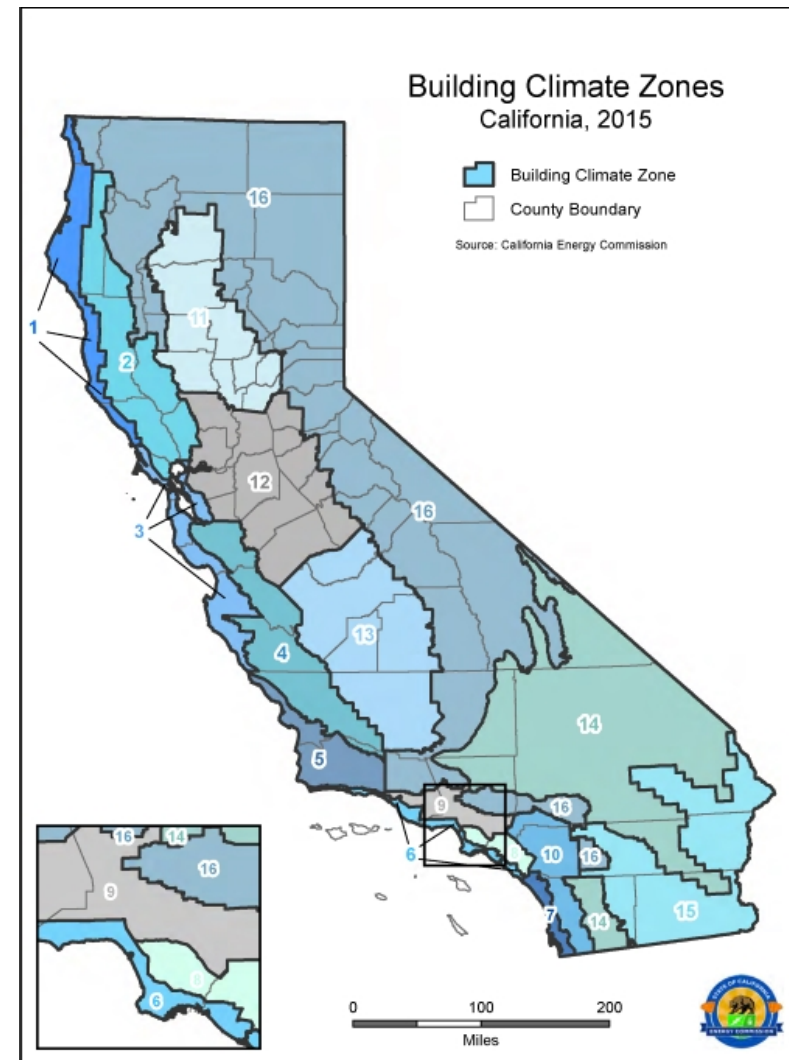
Oct. 11, 2016: Staff recommends EV Readiness (CalGreen) and Outdoor Lighting (Energy Code) reach codes to Council; proposes to wait on Mandatory Solar until CEC documents ready

Nov. 1, 2016: Council adopts CA Building Code with CalGreen and Energy Code amendments



# New 2016 Cost Effectiveness Study

- Provides cost-effective system sizing based on CA climate Zones
- Min. PV size based on % of total building “time dependent valuation” (TDV) of energy use
  - TDV values energy use differently depending on the fuel source, time of day, and season.
  - Reflects “societal value or cost” of energy including long-term projected costs of energy
  - Electricity used (or saved) during peak periods of the summer has a much higher value than electricity used (or saved) during off-peak periods



# 2016 Study Conclusions

- Finds solar PV in new residential developments are feasible and cost-effective in all 16 California climates zones.
- Cities can pass a local ordinance using the 2016 Cost-Effectiveness study as the basis if:
  - Buildings are required to first meet the mandatory Energy Code compliance without the use of the PV compliance credit (PVCC).
  - PV system sizes are based on the capacities shown in the study.

# CEC Template Ordinance

- Designed according to Cost-Effectiveness study recommendations
- Applies to Residential (Single & Multifamily) building types
- Provides prescriptive system sizes for units  $\leq 4,499$  sq. ft.
- For units/buildings  $\geq 4,500$  sq. ft., developers must model the system size to meet a minimum percentage of TDV energy usage
- Ordinance can be adopted as is, or with modifications

# PV System Sizing in Ordinance

## Climate Zone 3 (Fremont)

| Minimum PV System Size required to meet Solar PV Ordinance |                    |
|--|--------------------|
| Conditioned Space (ft <sup>2</sup> )                       | PV Size (kW DC)    |
| Less than 1000   | 1.5                |
| 1000 - 1499  | 1.7                |
| 1500 - 1999  | 2.1                |
| 2000 - 2499  | 2.4                |
| 2500 - 2999  | 2.7                |
| 3000 - 3499  | 3.0                |
| 3500 - 3999  | 3.2                |
| 4000 - 4499  | 3.5                |
| 4500 +   | 55% TDV Energy Use |

# Proposed Local Modifications

- Include all residential development types
- Provide for alternative compliance options:
  - Renewable energy systems other than rooftop solar, including ground-mounted or carport solar & wind energy systems
  - Increased energy efficiency (CALGreen Tier 1)
- Account for possible expanded system sizes:
  - Require developer to offer expanded system size to buyer.
  - Require developer to provide solar readiness beyond required system sizes per mandatory “solar zone” & “solar pathway”
  - Encourage developer to consider use of expandable technology
- Encourage an all-electric building energy system design

# Process Timeline (con't)

Mar. 3, 2017: Sustainability Commission reviews and approves CEC template ordinance

Apr. 18, 2017: Staff recommends Mandatory Solar Ordinance to Council

May 2, 2017: Council approves Mandatory Solar Ordinance

May 9, 2017: Staff files Energy Code Amendment documentation with CEC

May 11, 2017: CEC posts documentation for 60 day public comment period

Jul. 12, 2017: (scheduled) CEC Business Meeting for Solar Ordinance Approval



# Alignment with CA Goals

## California Zero Net Energy (ZNE) Goal:

- All new Res. by 2020; All new Non-Res & 50% existing Non-Res by 2030

## CA Renewable Portfolio Standard:

- 33% renewable by 2020 & 50% by 2030

## Statewide GHG Reduction Goal:

- 40% below 1990 levels by 2030 & 80% below by 2050





**Rachel A. DiFranco**

Sustainability Manager

City of Fremont

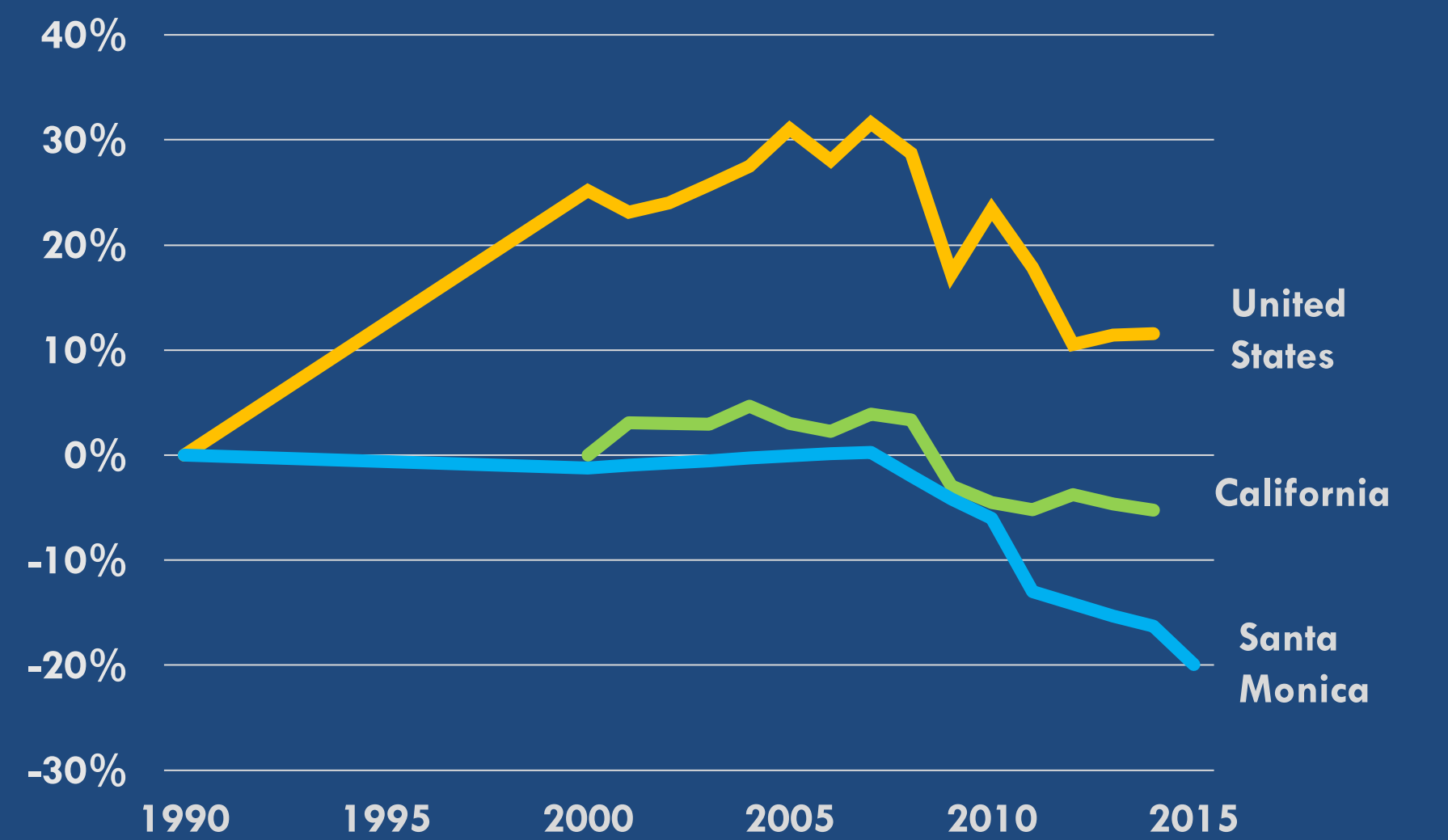
[rdifranco@fremont.gov](mailto:rdifranco@fremont.gov)

(510) 494-4451

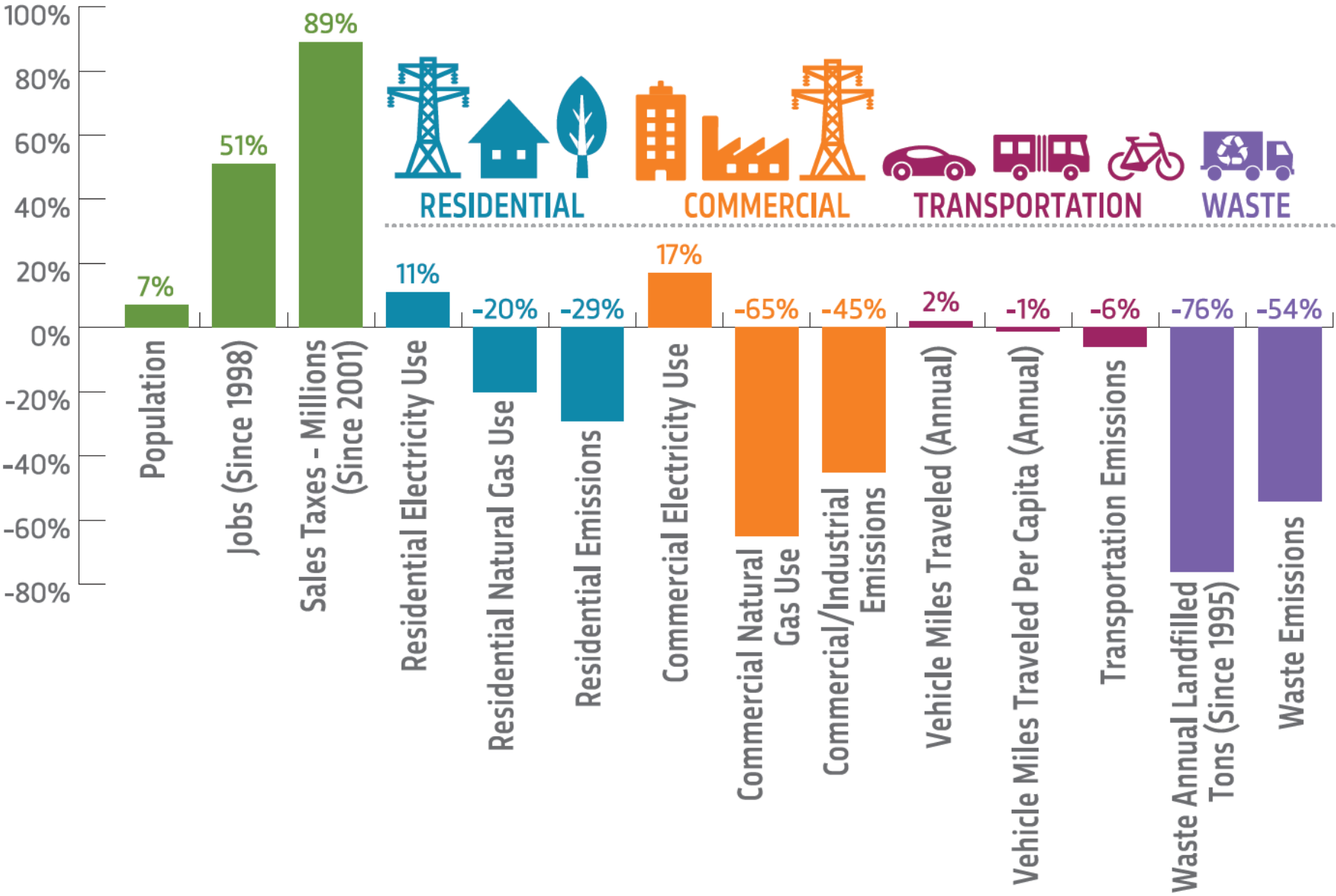
# **Santa Monica Zero Net Energy Reach Code**

Garrett Wong, Sr. Sustainability Analyst, Climate & Energy  
(Joel Cesare, Sustainable Building Advisor)

# Road to Carbon Neutrality: Santa Monica's emissions are down 20% below 1990 levels

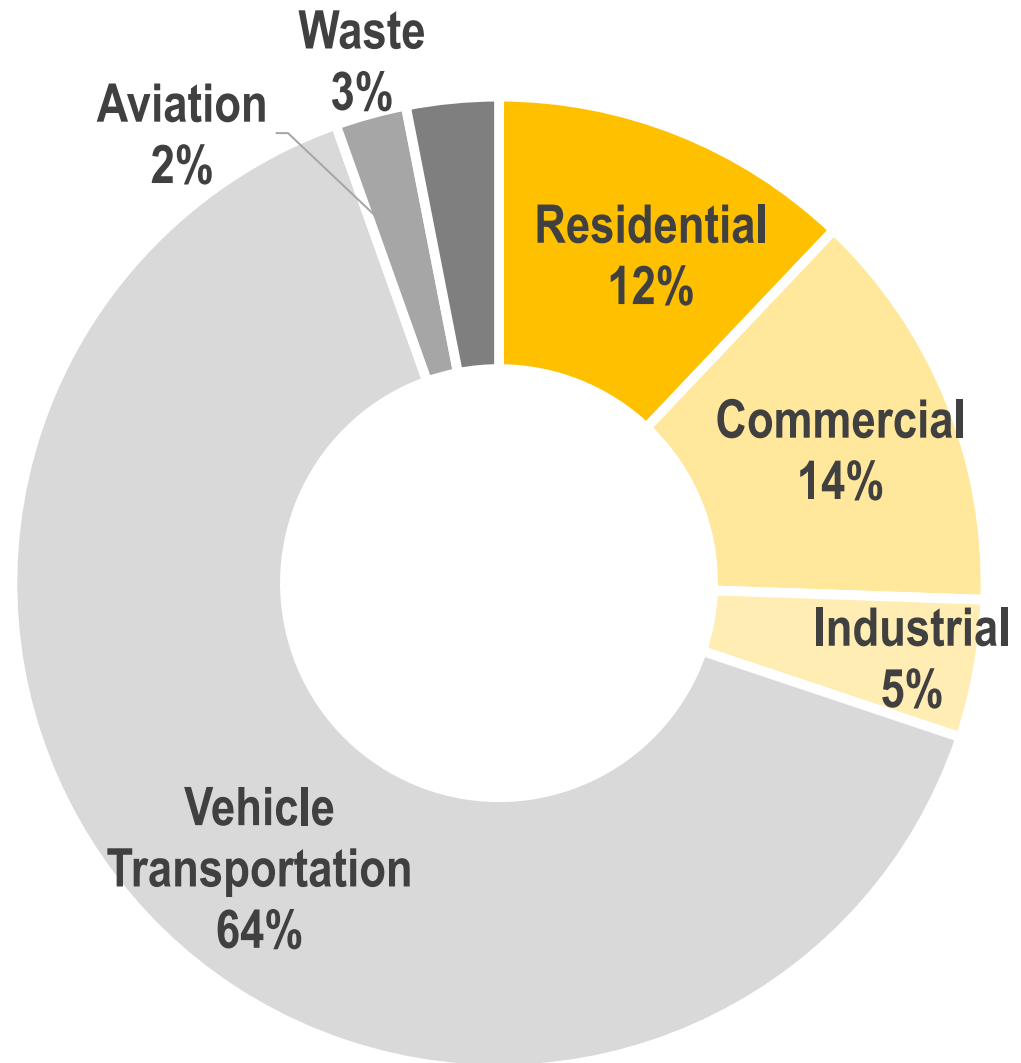


# Planet + Prosperity: Since 1990, population and economy have grown, while emissions have declined



**Building  
energy is  
responsible  
for 31% of  
Santa Monica's  
greenhouse  
gas emissions**

**Emissions by Source (2015)**





# Energy Code Timeline

Santa Monica  
Mandatory Solar  
Requirement

Expires 12/31/16

2016



Santa Monica  
Mandatory Solar  
Requirement  
&  
Energy Reach Code

Effective May 1, 2017

**MAY 2017**



State-wide  
Zero Net Energy  
Requirement  
(Commercial)

2030

**2017**

2016 CAL Green &  
California Energy Code  
requires solar

Effective 1/1/17



**2020**

State-wide  
Zero Net Energy  
Requirement  
(Single Family)



# 2012 Solar Ready

## Requirements

- Single family – 250 ft<sup>2</sup> of roof space
- All other buildings – 30% of roof area

## Roof Specifications

- Flat **OR** south-facing with  $\leq 33\%$  roof slope
- Unshaded
- Free from obstructions
- In contiguous areas of no less than 100 square feet
- Including required clearances for firefighting & life-safety access

# 2016 Solar Required

## Requirements

- Single family – 1.5 W / total sq ft
- All other buildings – 2 W / building footprint

## Alternative Compliance

- PV system or other RE that will offset 75%-100% of TDV energy budget
- Demonstrate TDV energy budget is reduced by the same wattage (energy efficiency)

## Exceptions

- Waived if infeasible
- Where there may be conflicts

# Developing the Reach Code

- CPUC funded pilot administered by SCE
- TRC Solutions conducted cost effectiveness study
- Challenges with timing, Council approval vs. CPUC approval

# Time Dependent Value

- Values hourly cost to customers, utility grid and society
- Creates common denominator between electricity, natural gas and propane
  - Electricity values change by the hour for each hour of the year
  - Natural gas and propane values change by month
- Provides a higher 'value' for energy used/saved during summer peak periods
- **On average, TDV-sized PV system is smaller than a PV system sized to offset actual/calculated site energy use**

# Energy Design Rating

**$\text{TDV Proposed} / \text{TDV Reference} \times 100 = \text{kTDV} / \text{sf-yr}$**

- Similar to 2015 IECC and 2014 RESNET
- 0-100 score represents the performance of a building meeting

***Zero or less  
represents high  
levels of energy  
efficiency and/or  
renewable generation  
to “zero out” its TDV  
energy use***

# Santa Monica Energy Efficiency Reach Code

## Chapter 8.36 Energy Code

### Low-rise residential.

All new low-rise residential buildings shall be designed to **use fifteen percent (15%) less energy** than the allowed energy budget established by the 2016 California Energy Code, **and achieve an Energy Design Rating of Zero.**

### High-rise residential, non-residential, hotels and motels.

All new high-rise residential buildings, non-residential buildings, hotels and motels shall be designed to **use ten percent (10%) less energy** than the allowed energy budget established by the 2016 California Energy Code.



| Building Type                      | Solar Requirement | Energy Code Requirement                                       |
|------------------------------------|-------------------|---|
| Single Family Home                 | 1.5 watts/sq.ft.  | Zero Net Energy:<br>15% better than 2016 Energy Code + EDR: 0 |
| Low-Rise Multi-Family              | 2 watts/sq.ft.    | Zero Net Energy:<br>15% better than 2016 Energy Code + EDR: 0 |
| High-Rise Multi-Family             | 2 watts/sq.ft.    | 10% better than 2016 Energy Code                              |
| Non-Res/ Industrial/ Institutional | 2 watts/sq.ft.    | 10% better than 2016 Energy Code                              |

# Putting the Code to Work

- **Outreach**

- Public presentations, notices in local industry distributions
- ZNE New Construction Guide

- **Training**

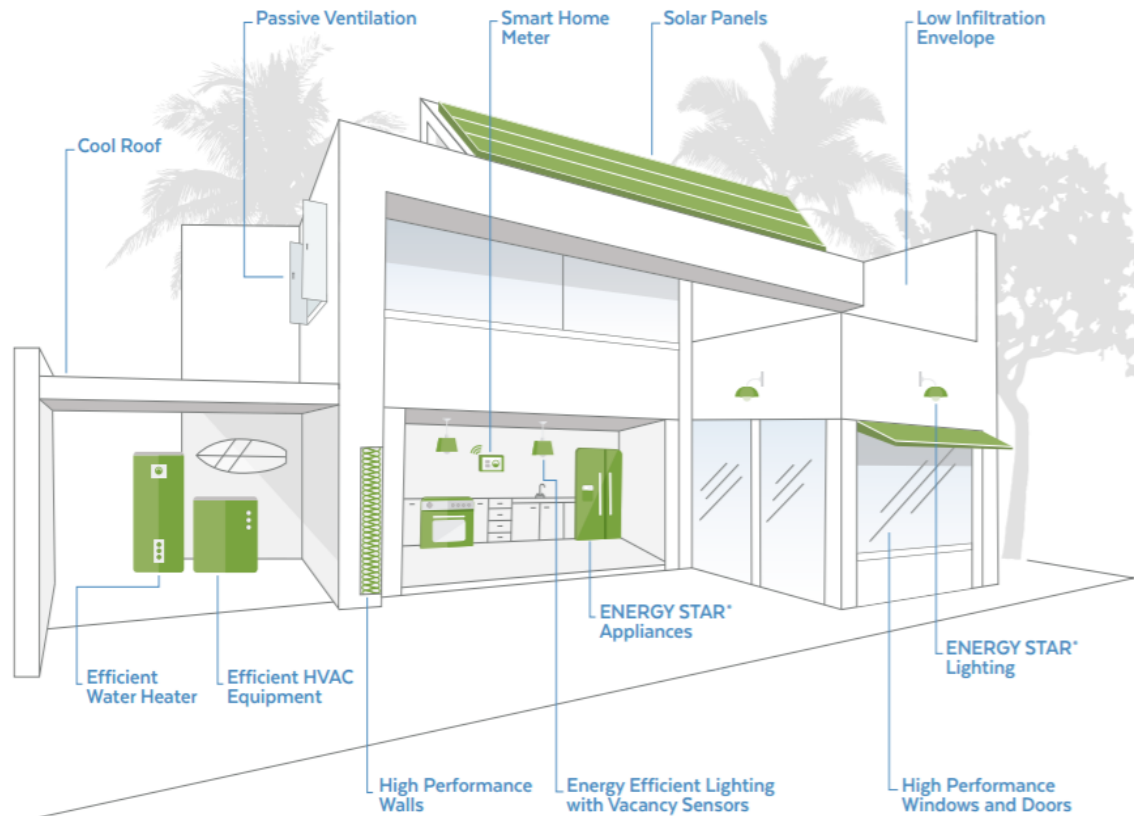
- Energy Code Ace + SCE for planners and inspectors

- **Energy Code Coach**

- Office hours available for contractors & architects

# Santa Monica Residential Zero Net Energy Guide for New Construction

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# Projects to Date - Residential

| Projects                                | Average<br>Sq Ft | Requirements    |
|---|------------------|-----------------|
| 29 single-family homes<br>167,072 sq ft | 5,761            | 251 kW solar    |
| 6 single-family homes<br>25,161 sq ft   | 5,659            | Zero Net Energy |

# Projects to Date - Commercial

| Projects             | Sq Ft  | Requirements   |
|----------------------|--------|--|
| 4 story commercial   | 33,827 | 2 W solar / sq ft<br>footprint<br><br>10% better than 2016 |
| 2 story core & shell | 7,500  | 2 W solar / sq ft<br>footprint<br><br>10% better than 2016 |

# Lessons Learned

- **Early collaboration with Planning and Building & Safety**
- **Consider alternative projects, i.e. pre-fab**
- **Establish tracking systems early**
- **Be prepared to be flexible**
- **Outreach, engage and educate!**



# Thank you!

Garrett Wong, Sr. Sustainability Analyst, Climate & Energy  
[garrett.wong@smgov.net](mailto:garrett.wong@smgov.net)

2017 SEEC Forum



OFFICE OF  
SUSTAINABILITY  

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COUNTY OF SAN MATEO



# Zero Net Energy Action in San Mateo County

Statewide Energy Efficiency Forum  
June 14, 2017

# Presentation

- What the Office of Sustainability does
  - Programs/Projects
- County Energy Programs
- Zero Net Energy Initiatives



OFFICE OF  
SUSTAINABILITY  

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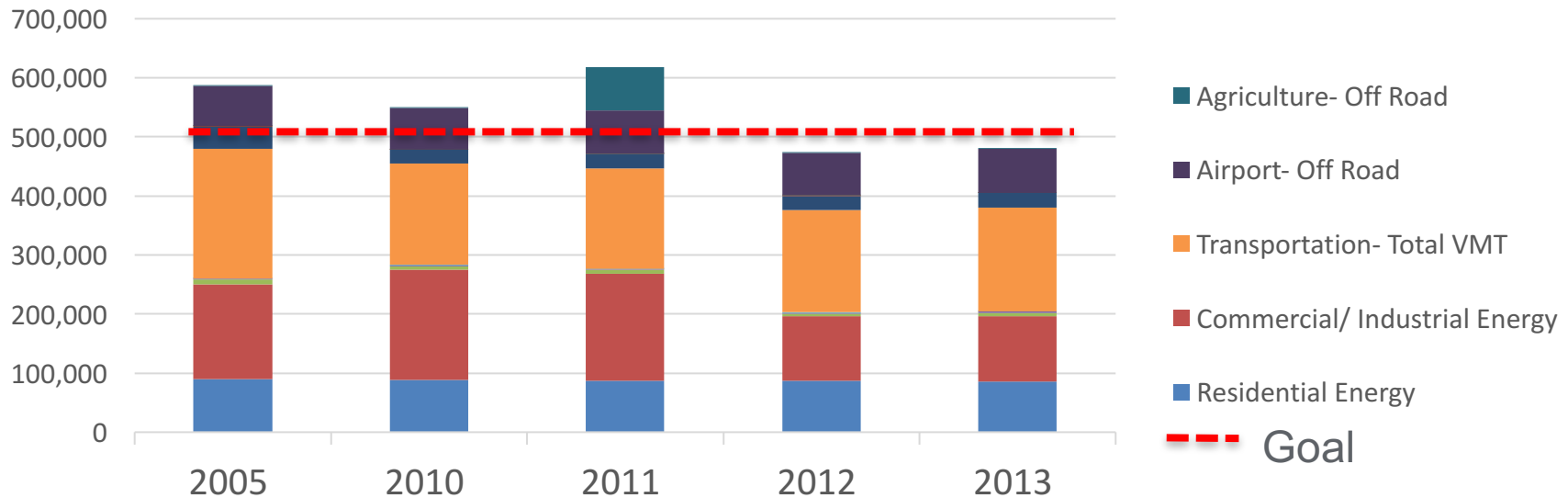
COUNTY OF SAN MATEO

# Solving For Tomorrow



# Climate Action Planning

## Community Emissions – Unincorporated



- Goal = 17% below 2005 by 2020
- Met goal in 2013

# County of San Mateo Energy Programs



A collaboration of the 9 Bay Area Counties led by ABAG working together for a sustainable energy future.

- Provides rebates and technical assistance for home upgrade projects on single family and multi family homes.
- Supports code compliance with training and forums for building professionals.
- Promotes ZNE policy development through templates, reach code assistance, and more!

# County of San Mateo Energy Programs



A collaboration of C/CAG, County of San Mateo  
Office of Sustainability, and PG&E

- Provides no-cost energy audits, special incentives, and benchmarking services to local governments, small businesses, non-profits, and some low income residents.
- Assist cities with climate action planning and GHG inventorying.
- SMC Energy Watch also hosts classes and trainings on energy efficiency and ZNE energy.



# SAN MATEO COUNTY energy watch

A Joint Project of:



COUNTY OF SAN MATEO  
OFFICE OF SUSTAINABILITY

About Us

Services

Paying For  
Projects

How To Save  
Energy

Events &  
Training

Countywide  
Climate Action

Progress  
Reports

Zero Energy  
Buildings



Public Facilities



Non-Profits



Schools



Homes



Farms



Businesses

Upcoming  
Events

Sign up for our  
newsletter

Newsletter archive

Check It Out! Energy  
and Water Saving  
Toolkit

## What Is Zero Energy?

[SMCEnergyWatch.com](http://SMCEnergyWatch.com)

## What is a Zero Energy Building?

A Zero Energy Building is a highly energy-efficient building that generates as much energy as it consumes through on-site renewable energy sources, such as solar panels or wind turbines.

While some members of the building community refer to these types of buildings as "Zero Net Energy" or "Zero Energy Ready," San Mateo County Energy Watch has decided to go with the overarching term "Zero Energy," in order to focus on and encourage the high energy performance of the building, instead of the renewable energy it can produce.

SMC Energy Watch defines Zero Energy Buildings as follows:

- Either Zero Net Energy (strongly encouraged), or, if Zero Net Energy is not feasible, Zero Energy Ready. Builders/owners must be able to demonstrate measures taken to achieve a high performance building and have accommodations for renewables in the future
- Renewables cover all site energy consumed, not source
- Does not allow for renewable energy certificates to count as renewable energy generated
- Energy purchased from a Community Choice Energy (CCE or CCA) source or other renewable utility portfolio does not count as renewable energy generated. Building must still have on-site renewable generation or a plan to implement it in the future
- Is able to accurately report energy use and energy generation data
- Building does NOT consume Natural Gas





# San Mateo County Energy Watch ZNE Framework and Strategic Plan

## **CEC PAEC Grant**

1. ZNE Lease Language
2. BEMS Analysis

## **Energy Watch Community Educational Materials**

1. Workshop Materials
2. Website and Videos
3. Webinars
4. City Engagement and assistance with reach codes

## **BayREN**

- 1. RFP Template Language
- 2. Engineering Analysis for Municipal Construction
- 3. ZNE Building Department Training

## **CPUC Pilot Project**

1. ZNE Policy for New Construction and Renovations
2. Developed toolkit for jurisdictions interested in crafting a ZNE Strategic Plan



**OFFICE OF  
SUSTAINABILITY**  
COUNTY OF SAN MATEO

# Progress



City of San Mateo Mandatory  
Solar Ordinance

City of Brisbane Mandatory  
Solar Ordinance



Half Moon Bay Library

Integration of ZNE into County  
construction projects



Multiple discussions with cities under

**RICAPS**  
Regionally Integrated Climate Action Planning Suite

# Available Resources

- RFP/OPR Templates, code compliance permit guides and online training: [BayRENCodes.org](http://BayRENCodes.org)
- ZNE Strategic Plan templates, Climate Action Plan templates and Educational Materials: [SMCEnergyWatch.com](http://SMCEnergyWatch.com)



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SUSTAINABILITY  

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COUNTY OF SAN MATEO

# THANK YOU!

Website: [sustainability.smcgov.org](http://sustainability.smcgov.org)

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